7.0 LOWER PLATTE RIVER BASIN

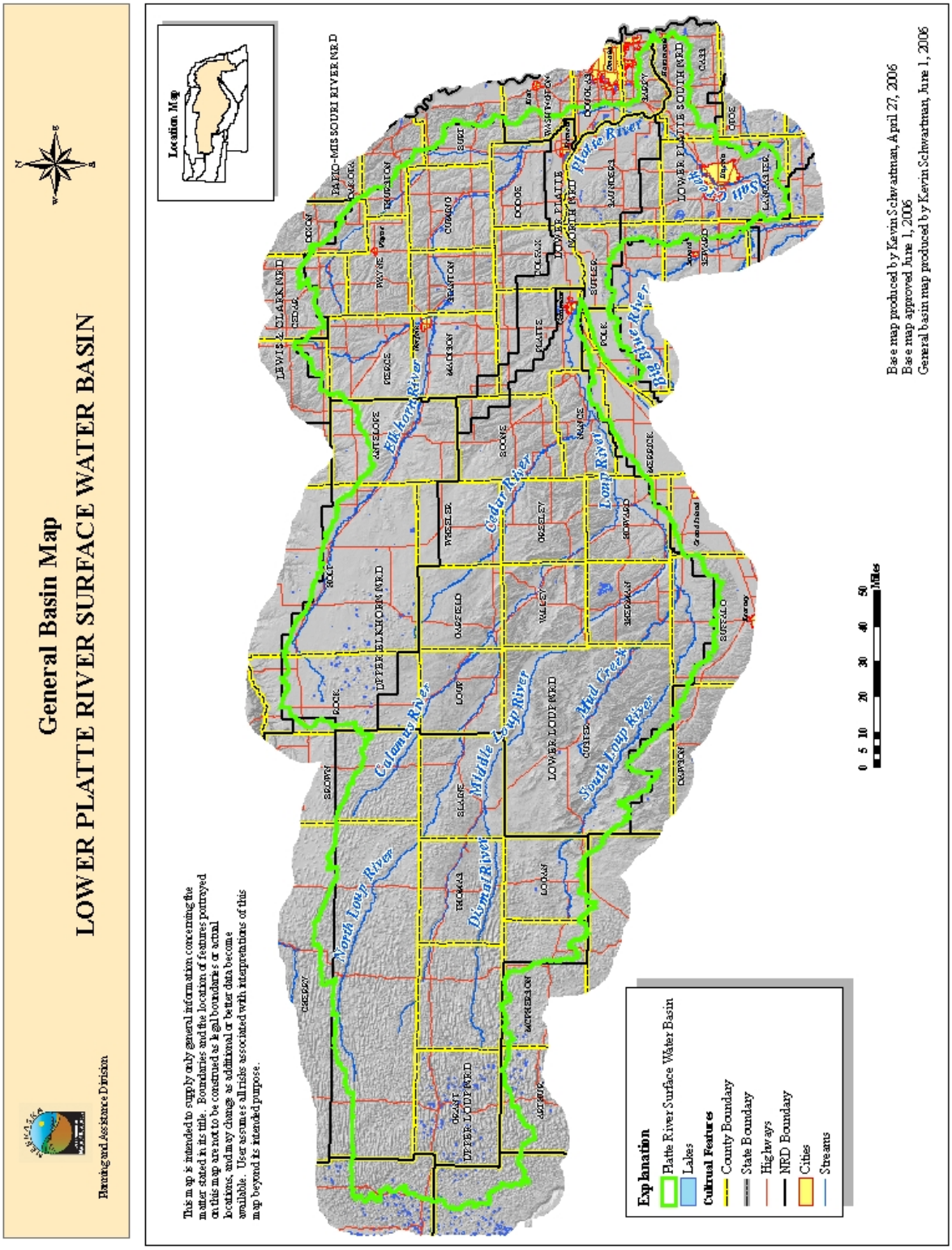
7.1 Summary

Based on the analysis of the sufficiency of the long-term surface water supply in the Lower Platte River Basin, the Department has reached a preliminary conclusion that, without the initiation of additional uses, the basin upstream of the confluence with the Missouri River is presently fully appropriated. The designation is the result of two factors. The first factor is that the current level of development will result in lag impacts such that the future water supply will be insufficient for junior surface water appropriations upstream of North Bend to satisfy the 65/85 rule completely. The second factor is that those same junior surface water appropriations are currently receiving less water than was available at the time the appropriations were granted (i.e., they have been eroded).

7.2 Basin Description

The Lower Platte River is defined as the reach of the Platte River from its confluence with the Loup River to its confluence with the Missouri River. The Lower Platte River Basin is defined as all surface areas that drain into the Lower Platte River, including those areas that drain into the Loup River and the Elkhorn River, and all aquifers that impact surface water flows of the basin (Figure 7-1). The total area of the Lower Platte River surface water basin is approximately 25,400 square miles, of which approximately 15,200 square miles are in the Loup River subbasin and approximately 7,000 square miles are in the Elkhorn River subbasin. Natural resources districts with significant area in the basin are the Lower Platte South Natural Resources District; the Lower Platte North Natural Resources District; the Upper Elkhorn Natural Resources District; the Lower Elkhorn Natural Resources District; the Upper Loup Natural Resources District; the Lower Loup Natural Resources District; and the Papio-Missouri River Natural Resources District.

Figure 7-1 General basin map, Lower Platte River Basin.



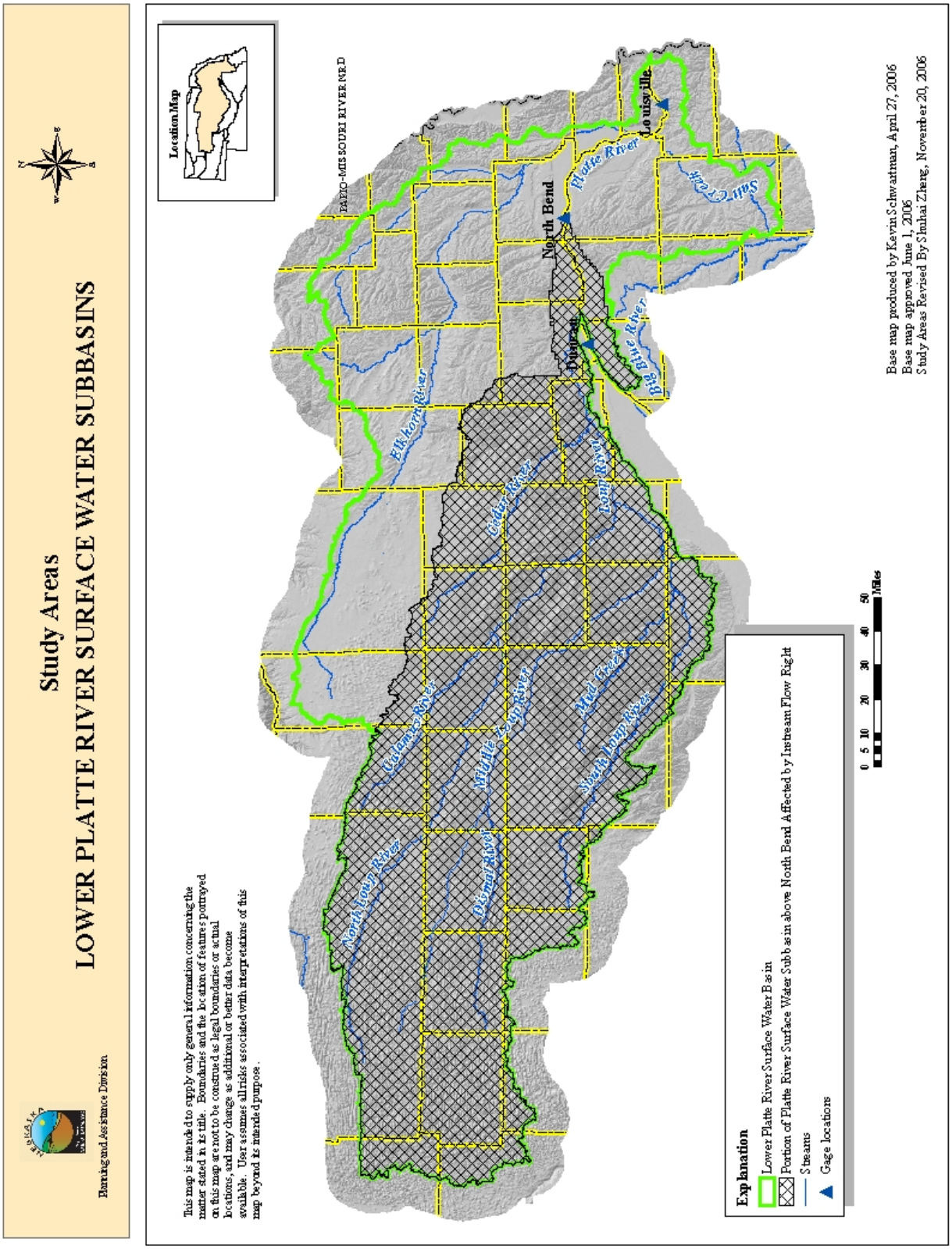
7.2.1 Subbasin Relationships

When considering the Lower Platte River Basin, it is important to understand the relationship between the senior surface water appropriations and the junior surface water appropriations in the Loup and Elkhorn River subbasins with regard to appropriations in the downstream portion of the Lower Platte River Basin. In general, when a senior water right calls for water, all water rights upstream of the senior right will be shut off to get water to the senior appropriator. Starting with the most junior appropriator, the Department will shut off as many junior appropriators as necessary to provide water to the senior appropriator. For senior appropriations along the Lower Platte River, this includes junior appropriators in the Loup and Elkhorn subbasins, because those subbasins provide flows to the reaches of the Lower Platte River that require administration for senior appropriators.

The senior appropriations calling for water in the Lower Platte River Basin are the instream flow rights. The instream flow rights have a priority date of November 30, 1993, and, when these appropriations are not being fulfilled, all surface water appropriations junior to that priority date will be closed. The instream flow appropriations are measured at the North Bend gage and the Louisville gage, although the appropriations extend to the confluence with the Missouri River. When instream flow appropriations are not met at the North Bend gage, all junior surface water appropriations above that gage, including those in the Loup River Basin, are closed to diversion (Figure 7-2). When instream flow appropriations are not met at both the North Bend and the Louisville gages, all junior surface water appropriations above both gages, including those in both the Loup and Elkhorn River subbasins, are closed to diversion. In circumstances where the instream flow appropriation is being met at the North Bend gage but not at the Louisville gage, all junior appropriations above the Louisville gage, including those in both the Loup and Elkhorn River subbasins, are closed to diversion.

Administration for the instream flow rights did not begin until 1997 when the permits were actually issued. Therefore, to evaluate a twenty-year record, the Department had to determine the number of days in which administration would have occurred if the instream flow rights had been in existence for the entire period of evaluation (1988-2007). Between 1988 and 2007, the junior surface water appropriations above North Bend, including those in the Loup River subbasin, would have been closed due to the instream flow appropriations not being met during July and August (the 65% time period from the 65/85 rule) for a total of 590 days. The junior surface water appropriations downstream of North Bend but upstream of Louisville would have been closed due to the instream flow appropriation not being met during July and August for a total of 549 days.

Figure 7-2 Map of the Platte River Basin highlighting the subbasin above the North Bend gage.



7.3 Nature and Extent of Water Use

7.3.1 Ground Water

Ground water in the basin is used for a variety of purposes: domestic, industrial, livestock, irrigation, and other uses. A total of 43,506 ground water wells had been registered within the basin as of December 31, 2007 (Department registered ground water wells database) (Figure 7-3). The locations of all active ground water wells can be seen in Figure 7-4.

Figure 7-3 Current well development by number of registered wells, Lower Platte River Basin.

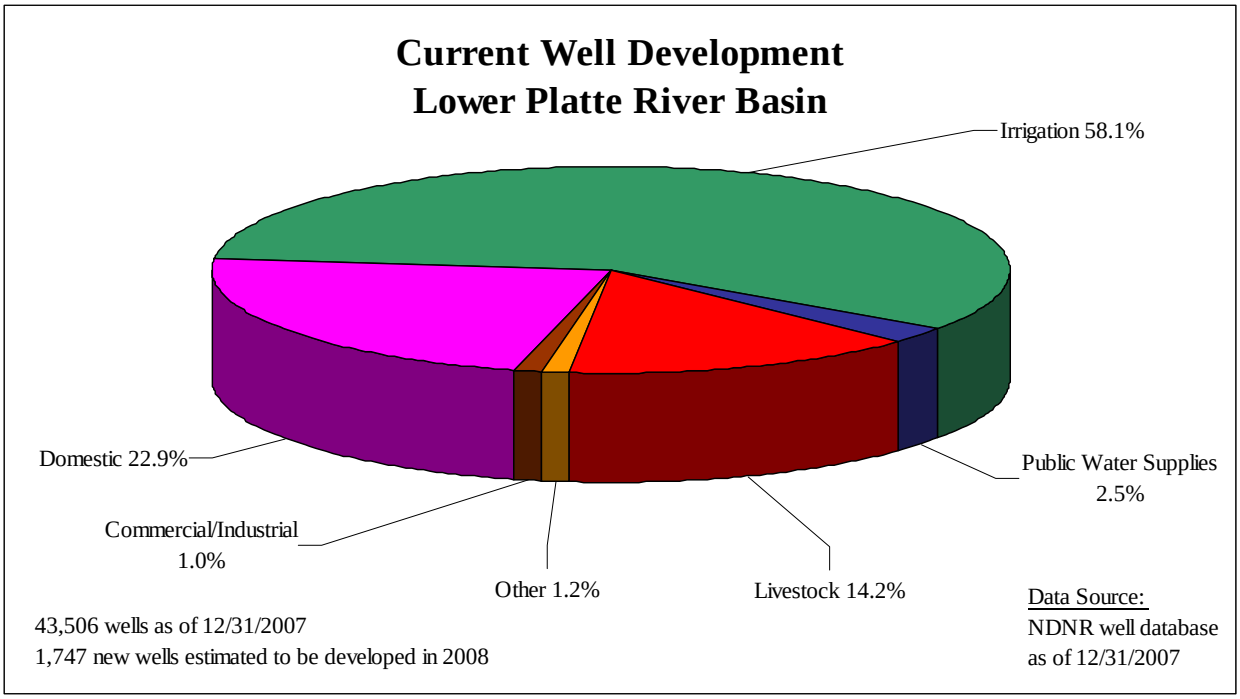
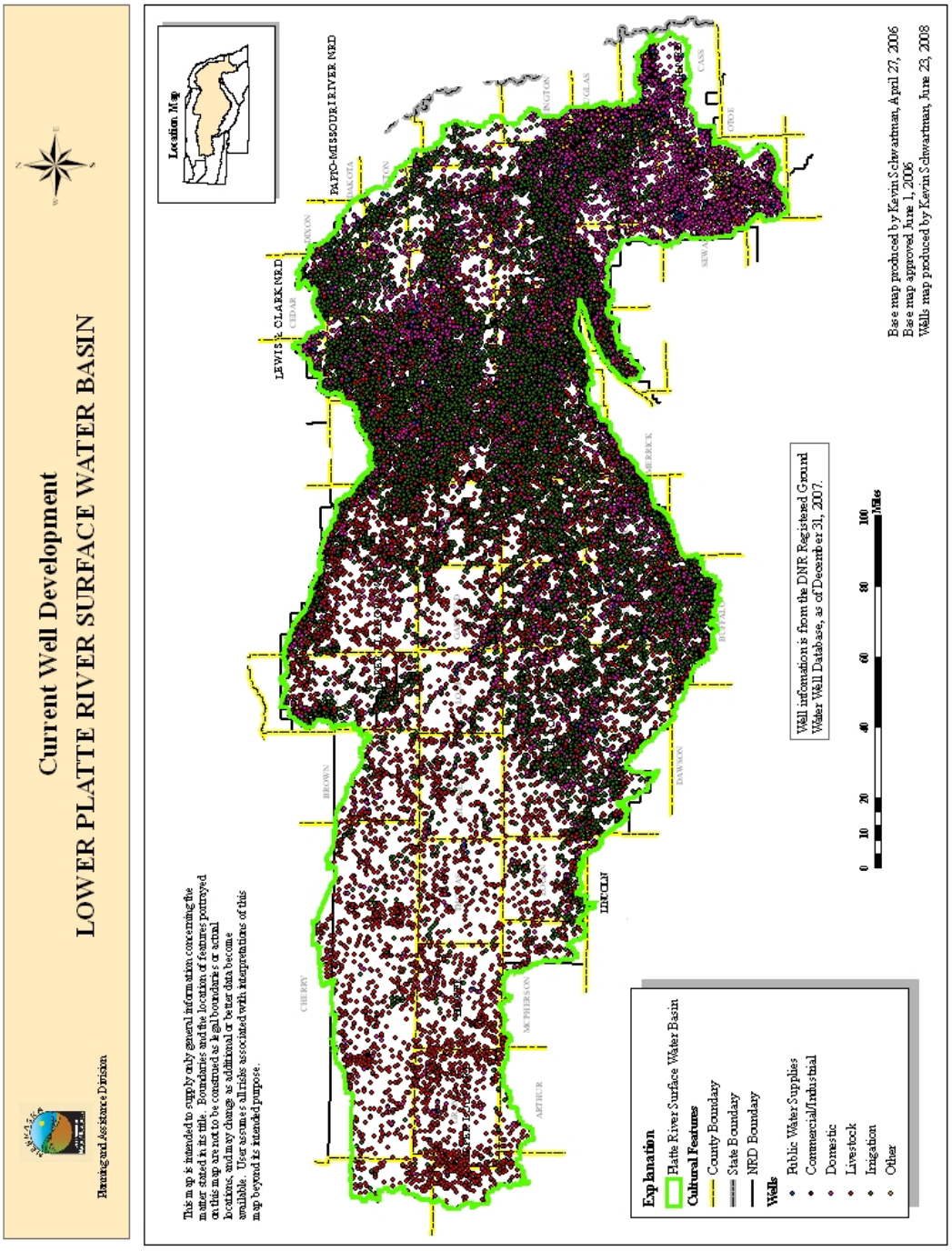


Figure 7-4 Current well locations, Lower Platte River Basin.



7.3.2 Surface Water

As of December 31, 2007, 2,935 surface water appropriations were held in the basin, issued for a variety of uses (Figure 7-5). Most of the surface water appropriations are for irrigation use and tend to be located on the major streams. In addition, two instream flow appropriations and two hydropower appropriations are held in the basin. The instream flow appropriations are located on the Platte River and are measured at North Bend and Louisville. The hydropower appropriations are located on the Loup River and the Cedar River. The first surface water appropriations in the basin were permitted in 1890, and development has continued through the present day. The approximate locations of the surface water diversion points are shown in Figure 7-6.

Figure 7-5 Surface water appropriations by number of diversion points, Lower Platte River Basin.

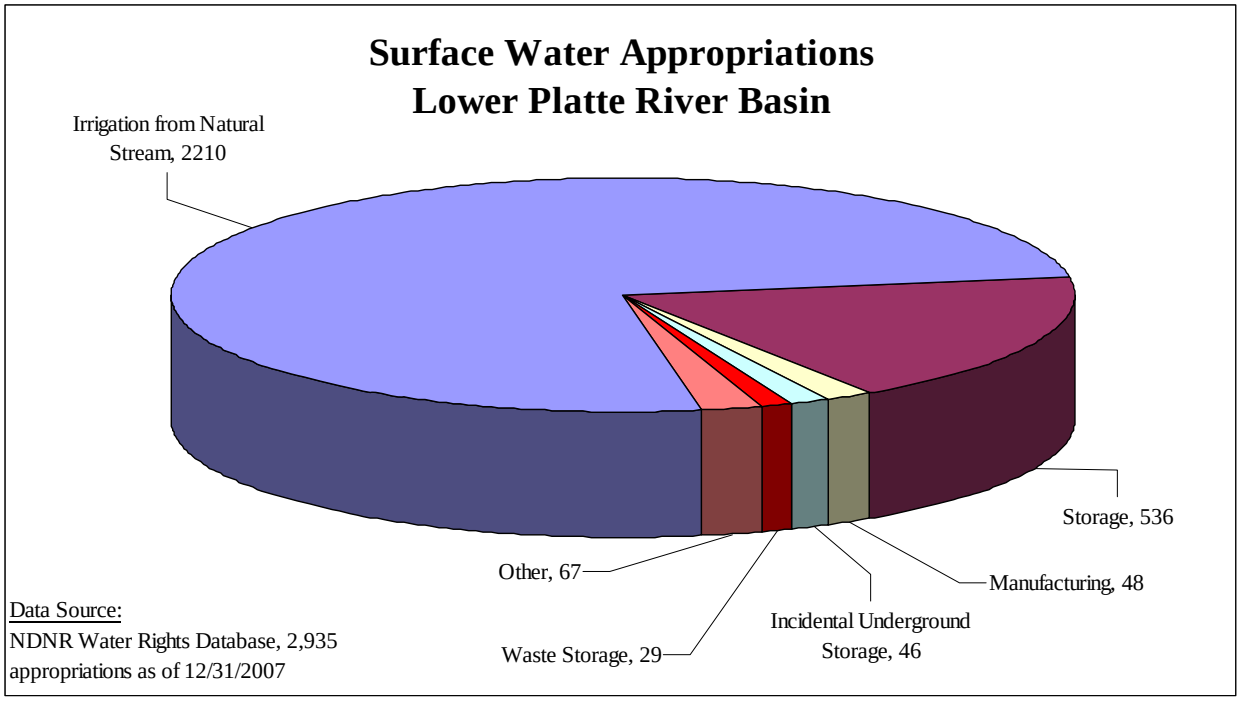
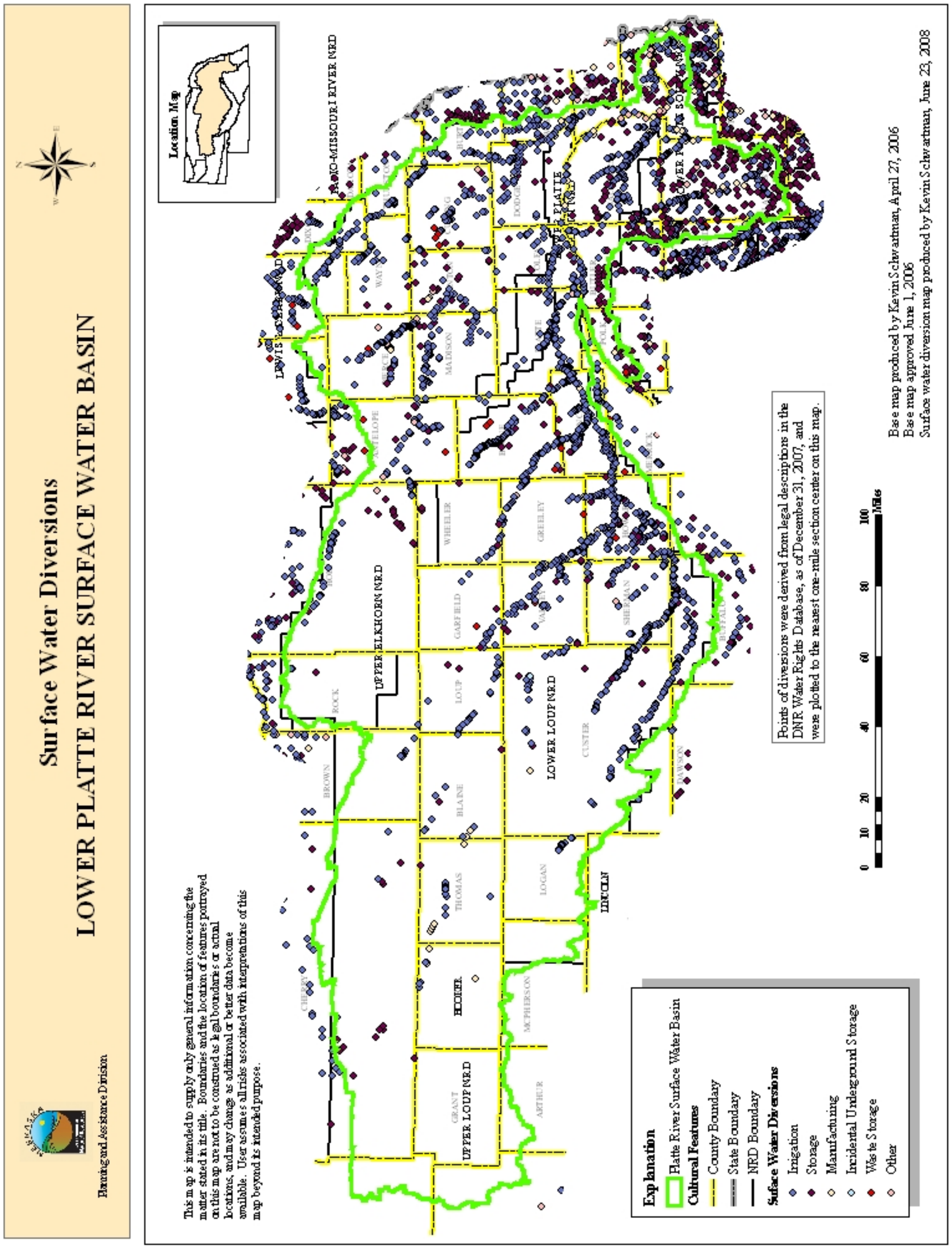


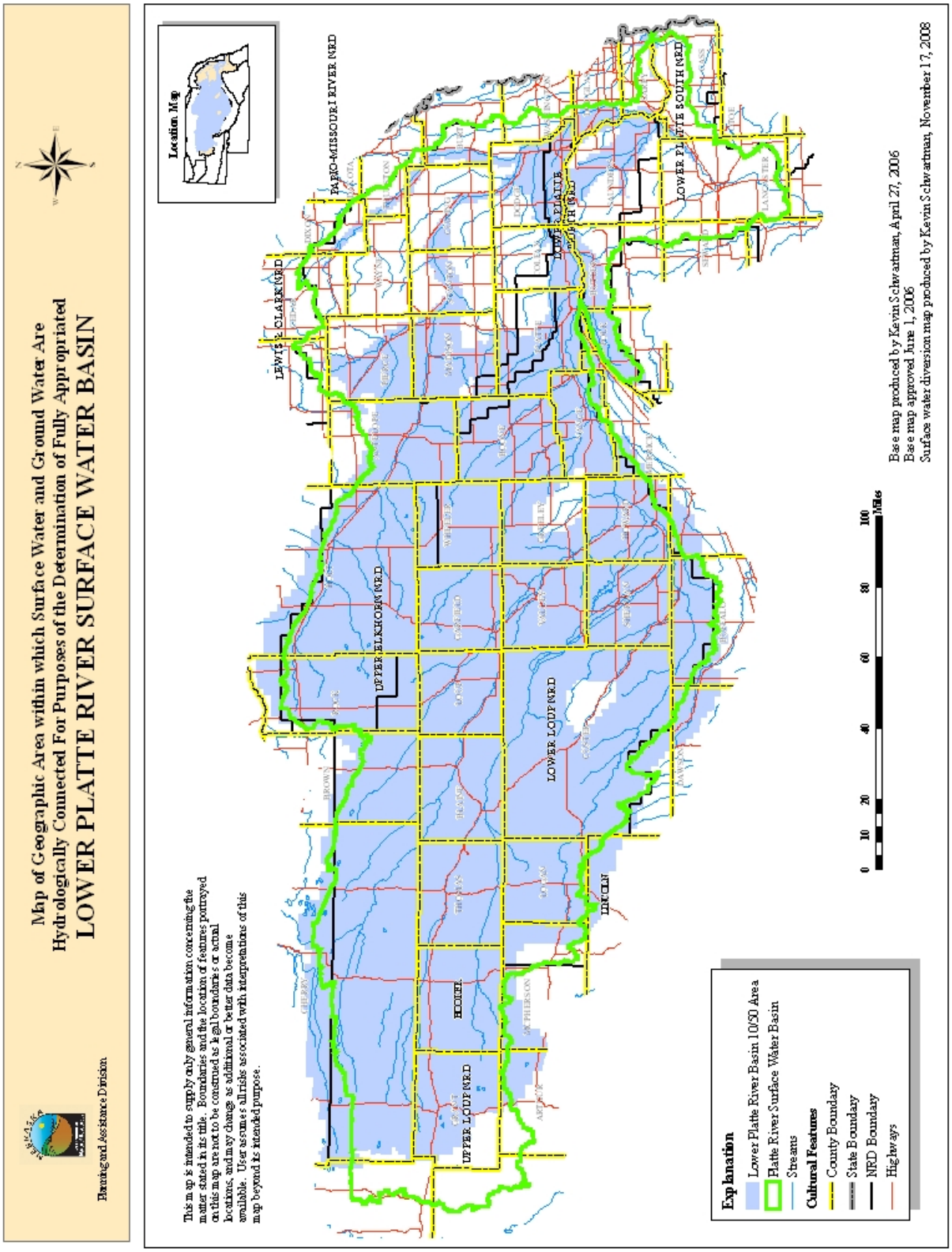
Figure 7-6 Surface water appropriation diversion locations, Lower Platte River Basin.



7.4 Hydrologically Connected Area

The Elkhorn-Loup model (ELM) was used to determine the extent of the 10/50 area for the Loup Basin and portions of the Elkhorn Basin. In areas which were not covered by the ELM but were considered to be hydrologically connected, the 10/50 area was determined using stream depletion factor (SDF) methodology. Figure 7-7 specifies the extent of the 10/50 area. A description of the SDF methodology used appears in the "Methodology" section of this report.

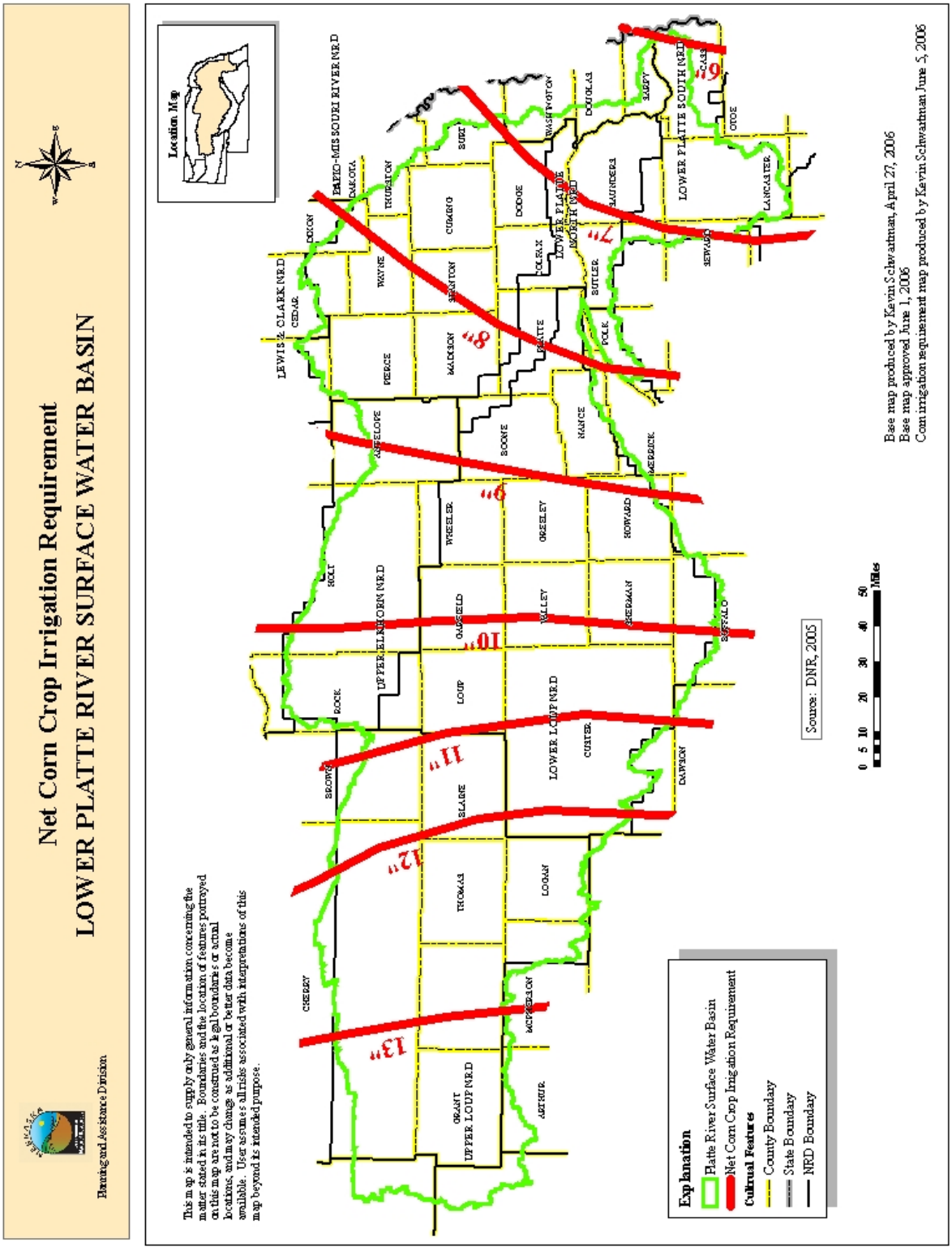
Figure 7-7 10/50 area, Lower Platte River Basin.



7.5 Net Corn Crop Irrigation Requirement

Figure 7-8 is a map of the net corn crop irrigation requirement for the Lower Platte River Basin (DNR, 2005). The NCCIR for a junior surface water appropriation above the North Bend gage is 10.52 inches. To assess the number of days required to be available for diversion, a surface water diversion rate equal to 1 cfs per 70 acres, a downtime of 10%, and an irrigation efficiency of 80% were assumed. Based on these assumptions, the most junior surface water appropriation would need 27.9 days annually to divert 65% of the NCCIR and 36.5 days to divert 85% of the NCCIR.

Figure 7-8 Net corn crop irrigation requirement, Lower Platte River Basin.



7.6 Surface Water Closing Records

Tables 7-1 and 7-2 record all surface water administration that has occurred in the basin above the North Bend and Louisville gages, respectively, between 1988 and 2007.

Table 7-1 Surface water administration in the Lower Platte River Basin above the North Bend gage, 1988-2007.

Year	Water Body	Days	Closing Date	Opening Date
2000	Lower Platte River Basin above North Bend	53	Aug 8	Sep 30
2001	Lower Platte River Basin above North Bend	11	Aug 7	Aug 18
2002	Lower Platte River Basin above North Bend	6	Jun 6	Jun 12
2002	Lower Platte River Basin above North Bend	67	Jun 25	Aug 31
2002	Lower Platte River Basin above North Bend	24	Sep 6	Sep 30
2003	Lower Platte River Basin above North Bend	81	Jul 11	Sep 30
2004	Lower Platte River Basin above North Bend	13	May 6	May 19
2004	Lower Platte River Basin above North Bend	7	Jun 29	Jul 6
2004	Lower Platte River Basin above North Bend	58	Jul 27	Sep 23
2005	Lower Platte River Basin above North Bend	48	Jul 12	Aug 29
2005	Lower Platte River Basin above North Bend	28	Sep 2	Sep 30
2006	Lower Platte River Basin above North Bend	35	May 15	Jun 20
2006	Lower Platte River Basin above North Bend	45	Jun 26	Aug 10
2006	Lower Platte River Basin above North Bend	28	Aug 14	Sep 11
2006	Lower Platte River Basin above North Bend	22	Oct 5	Oct 27
2006	Lower Platte River Basin above North Bend	20	Oct 31	Nov 20
2007	Lower Platte River Basin above North Bend	5	July 9	July 14

Table 7-2 Surface water administration in the Lower Platte River Basin above the Louisville gage, 1988-2007.

Year	Water Body	Days	Closing Date	Opening Date
1990	Willow Creek	14	Aug 17	Aug 31
1991	Taylor Creek	4	Jul 30	Aug 3
1991	Taylor Creek	3	Aug 23	Aug 26
1991	Taylor Creek	7	Aug 28	Sep 4
1991	Union Creek	7	Aug 28	Sep 4
2000	Lower Platte River Basin above Louisville	53	Aug 8	Sep 30
2001	Lower Platte River Basin above Louisville	11	Aug 7	Aug 18
2002	Lower Platte River Basin above Louisville	6	Jun 6	Jun 12
2002	Lower Platte River Basin above Louisville	59	Jun 25	Aug 23
2002	Lower Platte River Basin above Louisville	4	Aug 27	Aug 31
2002	Lower Platte River Basin above Louisville	24	Sep 6	Sep 30
2003	Lower Platte River Basin above Louisville	66	Jul 14	Sep 18
2004	Lower Platte River Basin above Louisville	13	May 6	May 19
2004	Lower Platte River Basin above Louisville	7	Jun 29	Jul 6
2004	Lower Platte River Basin above Louisville	58	Jul 27	Sep 23
2005	Lower Platte River Basin above Louisville	14	Jul 12	Jul 26
2005	Lower Platte River Basin above Louisville	31	Jul 29	Aug 29
2005	Lower Platte River Basin above Louisville	28	Sep 2	Sep 30
2006	Lower Platte River Basin above Louisville	35	May 16	Jun 20
2006	Lower Platte River Basin above Louisville	45	Jun 26	Aug 10
2006	Lower Platte River Basin above Louisville	28	Aug 14	Sep 11
2006	Lower Platte River Basin above Louisville	22	Oct 5	Oct 27
2006	Lower Platte River Basin above Louisville	20	Oct 31	Nov 20
2007	Lower Platte River Basin above Louisville	5	July 9	July 14

7.7 Evaluation of Current Development

7.7.1 Current Water Supply

The current water supply is estimated by using the previous twenty years (1988-2007) of flows and comparing them to the flows necessary to satisfy the senior surface water appropriation (i.e., the instream flow appropriations). The results of the analyses conducted for the Lower Platte River Basin above North Bend and above Louisville, respectively, are shown in Tables 7-3 and 7-4. The results indicate that the current surface water supply in the Lower Platte River Basin above North Bend provides an average of

32.5 days available for diversion between July 1 and August 31 and 103.9 days available for diversion between May 1 and September 30 (Table 7-5). The results for the Lower Platte River Basin above Louisville indicate an average of 34.6 days available for diversion between July 1 and August 31 and 106.8 days available for diversion between May 1 and September 30 (Table 7-6).

Table 7-3 Estimate of the current number of days surface water is available for diversion above North Bend.

Year	**July 1 though August 31 Number of Days Surface Water is Available for Diversion**	**May 1 through September 30 Number of Days Surface Water is Available for Diversion**
1988	10	69
1989	14	47
1990	16	77
1991	6	66
1992	62	153
1993	62	153
1994	56	143
1995	52	134
1996	62	153
1997	40	131
1998	62	153
1999	61	152
2000	32	94
2001	28	111
2002	2	48
2003	6	72
2004	20	75
2005	10	71
2006	0	6
2007	49	140
Average	32.5	103.9

Table 7-4 Estimate of the current number of days surface water is available for diversion above Louisville.

Year	July 1 though August 31 Number of Days Surface Water is Available for Diversion	May 1 through September 30 Number of Days Surface Water is Available for Diversion
1988	10	69
1989	15	49
1990	18	79
1991	10	71
1992	62	153
1993	62	153
1994	59	149
1995	53	144
1996	62	153
1997	43	134
1998	62	153
1999	62	153
2000	35	97
2001	34	118
2002	5	51
2003	11	77
2004	22	78
2005	12	73
2006	3	40
2007	51	142
Average	34.6	106.8

Table 7-5 Comparison between the number of days required to meet the net corn crop irrigation requirement and number of days surface water is available for diversion above North Bend.

	Number of Days Necessary to Meet the 65% and 85% of Net Corn Crop Irrigation Requirement	**Average Number of Days Available for Diversion with Current Development**
July 1 – August 31 (65% Requirement)	27.9	32.5 (4.6 days above the requirement)
May 1 – September 30 (85% Requirement)	36.5	103.9 (67.4 days above the requirement)

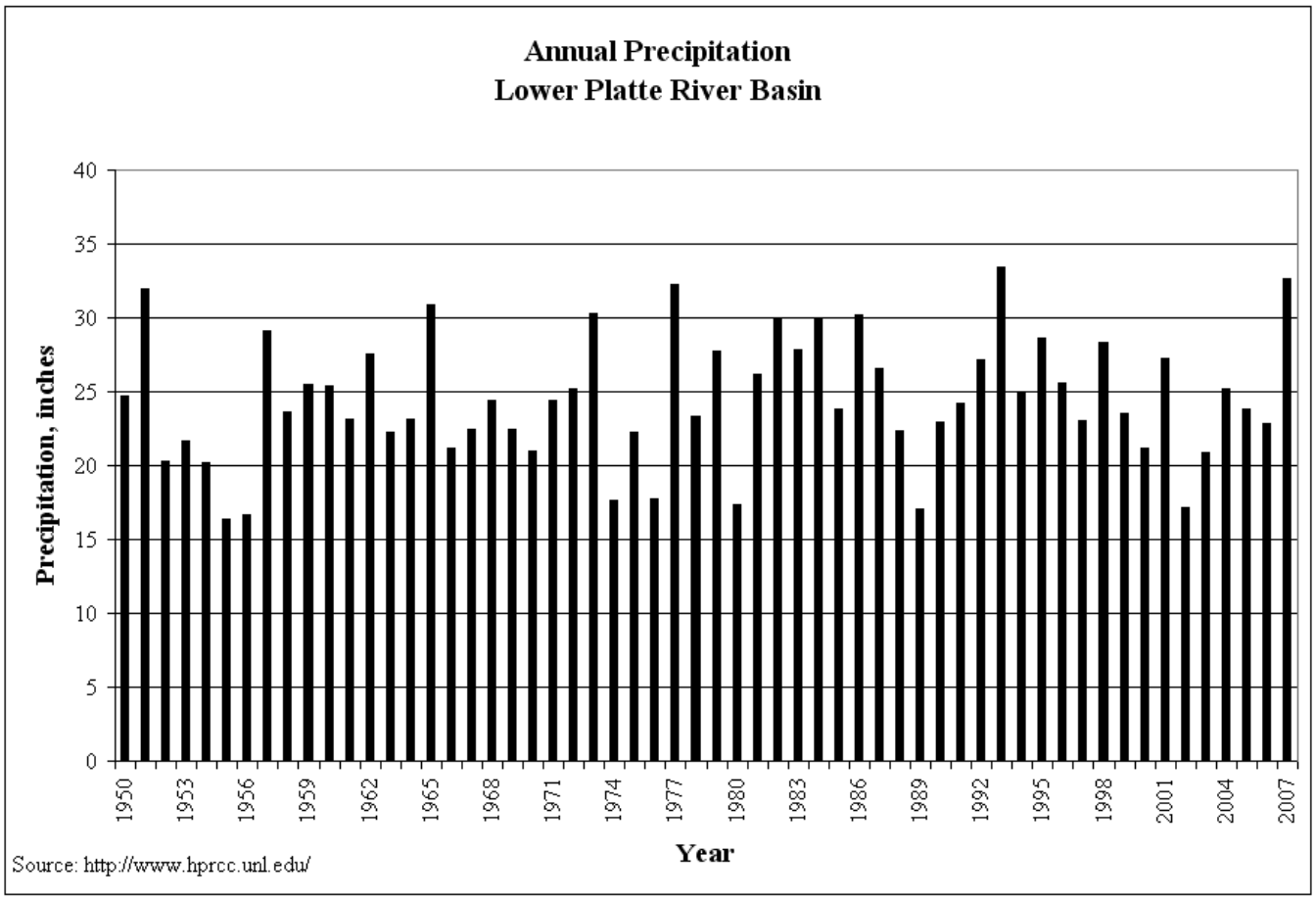
Table 7-6 Comparison between the number of days required to meet the net corn crop irrigation requirement and number of days surface water is available for diversion above Louisville.

	Number of Days Necessary to Meet the 65% and 85% of Net Corn Crop Irrigation Requirement	**Average Number of Days Available for Diversion with Current Development**
July 1 – August 31 (65% Requirement)	27.9	34.6 (6.7 days above the requirement)
May 1 – September 30 (85% Requirement)	36.5	106.8 (70.3 days above the requirement)

7.7.2 Water Supply

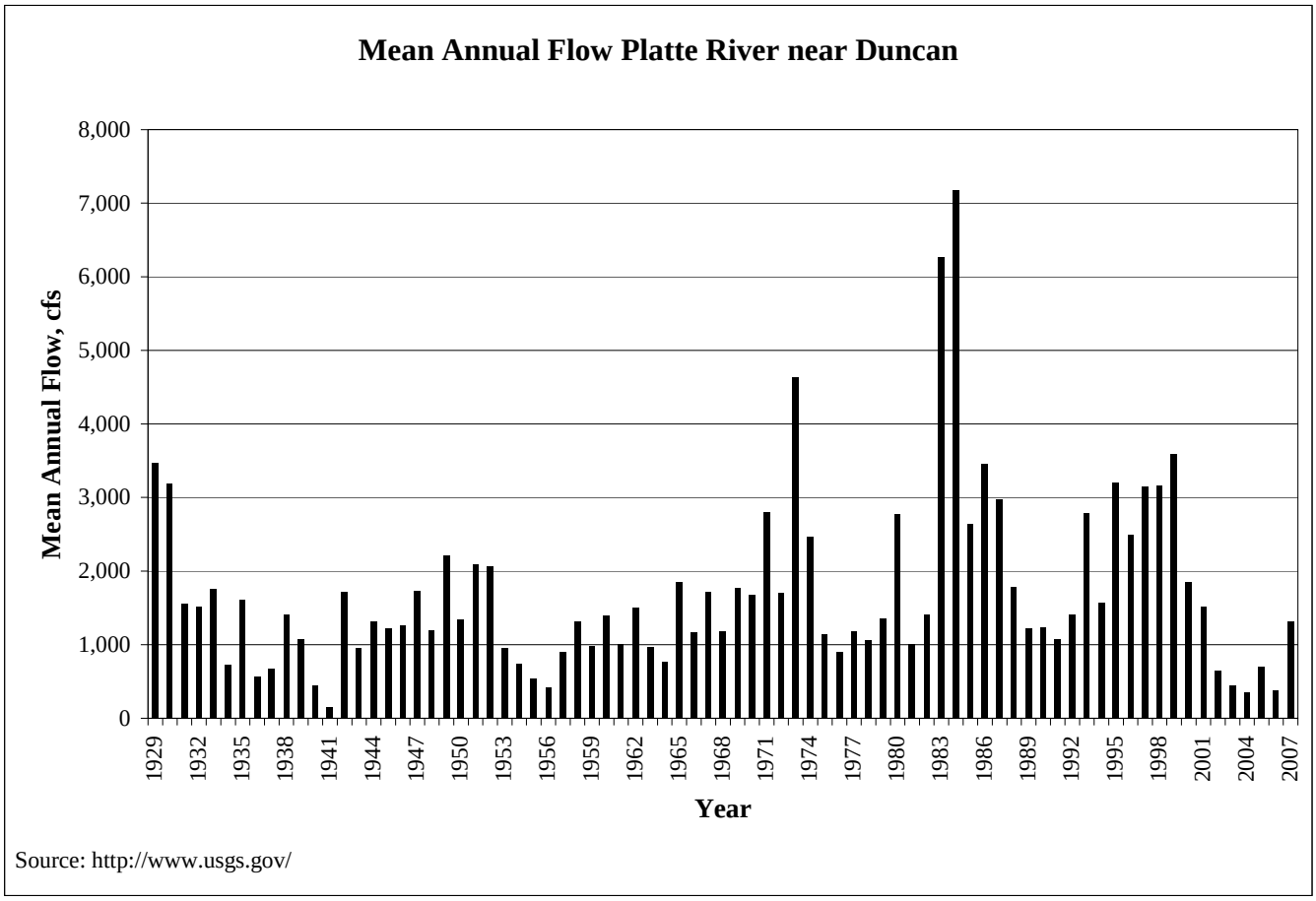
In order to complete the long-term evaluation of surface water supplies, a future twenty-year water supply for the basin must be estimated. The basin's major water sources are precipitation, which runs off as direct streamflow and infiltrates into the ground to discharge as baseflow; ground water movement into the basin, which discharges as baseflow; and streamflow from the middle Platte River. Using methodology published in the *Journal of Hydrology* (Wen and Chen, 2005), a nonparametric Mann-Kendall trend test of the weighted average precipitation in the basin was completed. The analysis showed no statistically significant trend in precipitation ($P > 0.95$) over the past fifty years (Figure 7-9). The same type of statistical analysis of streamflow from the middle Platte River, using the Platte River at Duncan gage as inflow to the Lower Platte Basin), also showed no statistically significant trend ($P > 0.95$) (Figure 7-10). Therefore, using the previous twenty years of precipitation and streamflow data as the best estimate of the future surface water supply is a reasonable starting point for applying the lag depletions from ground water wells.

Figure 7-9 Annual precipitation, Lower Platte River Basin[1]



[1] The results include precipitation stations covering the Loup, Elkhorn, and Platte River Basins.

Figure 7-10 Mean annual flow, Platte River near Duncan



Source: http://www.usgs.gov/

7.7.3 Depletions Analysis

The future depletions due to current well development that could be expected to affect streamflow in the basin were estimated using the ELM for the Loup Basin and portions of the Elkhorn Basin, whereas the SDF methodology was used in all other areas where data exist. The results estimate the future streamflow at North Bend to be depleted by 445 cfs in twenty-five years and flows at Louisville to be depleted by 870 cfs in twenty-five years. The future depletion at Louisville includes 160 cfs[1] from the Metropolitan Utilities District wellfield being developed upstream of the confluence of the Platte and Elkhorn Rivers.

[1]This is the amount of water that is permitted to be pumped from the stream by the wellfield, not the entire amount of water for which the induced recharge permit was granted.

7.7.4 Evaluation of Current Levels of Development against Future Water Supplies

The estimates of the twenty-year average number of days available for diversion are calculated by comparing the lag-adjusted future water supply with the flows necessary to satisfy the senior calling surface water appropriations (in this case, the instream flow rights) that have caused administration of junior appropriations in the basin. The results of the analyses are shown in Tables 7-7 and 7-8. The results of the analyses as compared to the numbers of days surface water is required to be available to divert 65% and 85% of the NCCIR are detailed in Tables 7-9 and 7-10. The long-term surface water supply estimates, given current levels of development, are not sufficient to meet the needs of the junior surface water appropriations for the Lower Platte River Basin above North Bend. Additionally, continued development downstream of North Bend and upstream of the Missouri River confluence will further reduce the number of days available to junior irrigators because of an increased frequency of calls by the instream flow appropriation measured at Louisville.

Table 7-7 Estimate of days surface water is available for diversion above North Bend with current development and twenty-five-year lag impacts.

Year	July 1 though August 31 Number of Days Surface Water is Available for Diversion	May 1 through September 30 Number of Days Surface Water is Available for Diversion
1	3	52
2	12	36
3	9	70
4	2	61
5	55	127
6	62	153
7	46	118
8	46	119
9	57	148
10	38	129
11	60	141
12	59	150
13	14	72
14	7	76
15	0	37
16	3	65
17	16	57
18	5	66
19	0	25
20	36	127
Average	26.5	91.5

Table 7-8 Estimate of days surface water is available for diversion above Louisville with current development and twenty-five-year lag impacts.

Year	July 1 though August 31 Number of Days Surface Water is Available for Diversion	May 1 through September 30 Number of Days Surface Water is Available for Diversion
1	3	52
2	12	37
3	11	72
4	5	64
5	55	128
6	62	153
7	48	131
8	48	127
9	57	148
10	40	131
11	61	142
12	62	153
13	21	80
14	13	83
15	3	40
16	6	69
17	16	57
18	7	68
19	2	28
20	36	127
Average	28.4	94.5

Table 7-9 Comparison between the number of days required to meet the net corn crop irrigation requirement and number of days surface water is available for diversion above North Bend with current development and lag impacts.

	Number of Days Necessary to Meet the 65% and 85% of Net Corn Crop Irrigation Requirement	**Average Number of Days Available for Diversion at Current Development with 25 Years of Lag Impacts**
July 1 – August 31 (65% Requirement)	27.9	26.5 (1.4 days below the requirement)
May 1 – September 30 (85% Requirement)	36.5	91.5 (55.0 days above the requirement)

Table 7-10 Comparison between the number of days required to meet the net corn crop irrigation requirement and number of days surface water is available for diversion above Louisville with current development and lag impacts.

	Number of Days Necessary to Meet the 65% and 85% of Net Corn Crop Irrigation Requirement	**Average Number of Days Available for Diversion at Current Development with 25 Years of Lag Impacts**
July 1 – August 31 (65% Requirement)	27.9	28.4 (0.5 days above the requirement)
May 1 – September 30 (85% Requirement)	36.5	94.5 (58.0 days above the requirement)

7.8 Erosion of Junior Surface Water Appropriations

The erosion rule was applied to evaluate whether, at the time that junior surface water irrigation appropriations were granted, flows could have satisfied the 65/85 rule and, therefore, whether the junior rights have been eroded. The results of the analysis are shown in Table 7-11 below. The results indicate

that the junior surface water irrigation appropriation, granted in 2000, would have been able to divert on average 36.3 days between July 1 and August 31 and 108.5 days between May 1 and September 30 for the twenty-year period prior to 2000. This is greater than the average number of days that are currently available for diversion (26.5 days between July 1 and August 31, and 91.5 days between May 1 and September 30) by 9.8 days and 17.0 days, respectively. Thus, the junior irrigation rights have been eroded.

Table 7-11 Comparison between the number of days available to junior appropriators for diversion at the time appropriations were obtained and the number of days currently available for diversion, in the Lower Platte River Basin above North Bend.

	Number of Days Required to Meet the Net Corn Crop Irrigation Requirement	**Number of Days Available to a Junior Irrigator (1981-2000)**	**Number of Days Currently Available for Diversion (1988-2007)**
July 1 – August 31 (65% Requirement)	27.9	36.3	26.5
May 1 – September 30 (85% Requirement)	36.5	108.5	91.5

7.8.1 Fully Appropriated Area

Based on the analysis of current water supplies, the Lower Platte River Basin upstream of the Missouri River confluence is fully appropriated (Figure 7-11 and 7-12). The lag-adjusted future water supplies are insufficient to satisfy completely the 65/85 rule for junior irrigators above North Bend. Additionally, water supplies to junior irrigation surface water appropriations have been eroded from those which were expected at the time the appropriations were granted. The entire Lower Platte River Basin upstream of the confluence with the Missouri River is included in this designation because the combination of the lag impacts upstream of North Bend and the lag impacts downstream of North Bend and upstream of the

confluence with the Missouri River that will cause water supplies to be insufficient to satisfy the 65/85 rule completely (Table 7-12). Table 7-12 illustrates how the number of days available to satisfy the 65 portion of the 65/85 rule decrease as the level of lag impacts measured at Louisville increases.

Table 7-12 The relationship between the number of days available for diversion upstream of North Bend and the lag impacts for areas downstream of North Bend.

Number of Days Required to Meet 65% of the Net Corn Crop Irrigation Requirement	**Number of Days Available to Junior Irrigators upstream of North Bend**	**Lag Impacts from Current Levels of Well Development Upstream of North Bend (cfs)**	**Lag Impacts from Current Levels of Well Development in the Lower Platte Basin Downstream of North Bend and Upstream of the Missouri River Confluence (cfs)**	**Total Combined Lag Impacts Upstream of the Missouri River Confluence (cfs)**
27.9	28.0	445[1]	100	545
27.9	27.9	445[1]	150	595
27.9	27.6	445[1]	200	645
27.9	27.5	445[1]	250	695
27.9	27.0	445[1]	300	745
27.9	26.8	445[1]	350	795
27.9	26.6	445[1]	400	845
27.9	26.5[1]	445[1]	425[1]	870[1]

[1] Value determined for this years report based on lag impacts of current levels of development

Figure 7-11 Area designated as fully appropriated within the Lower Platte River Basin.

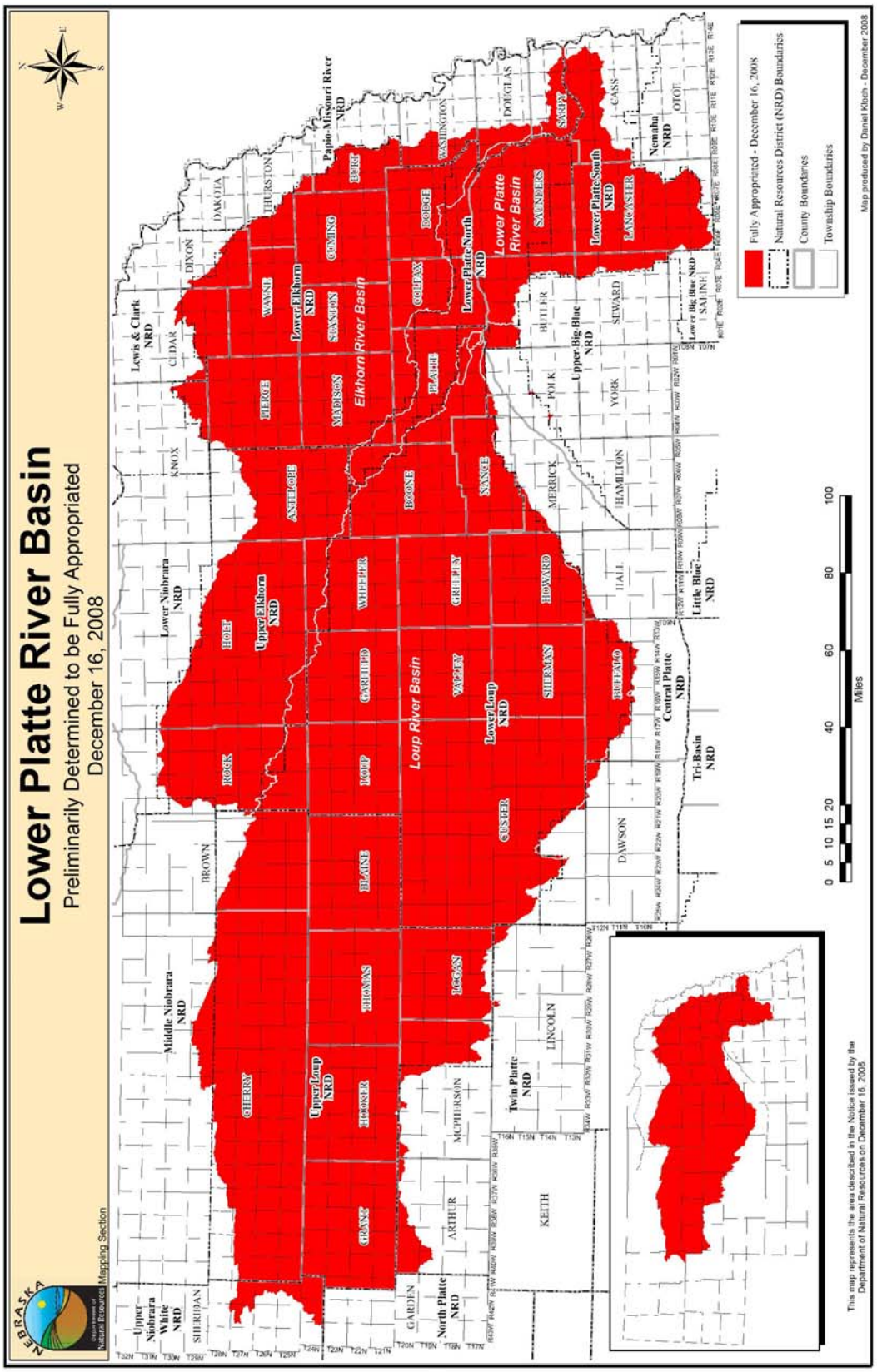
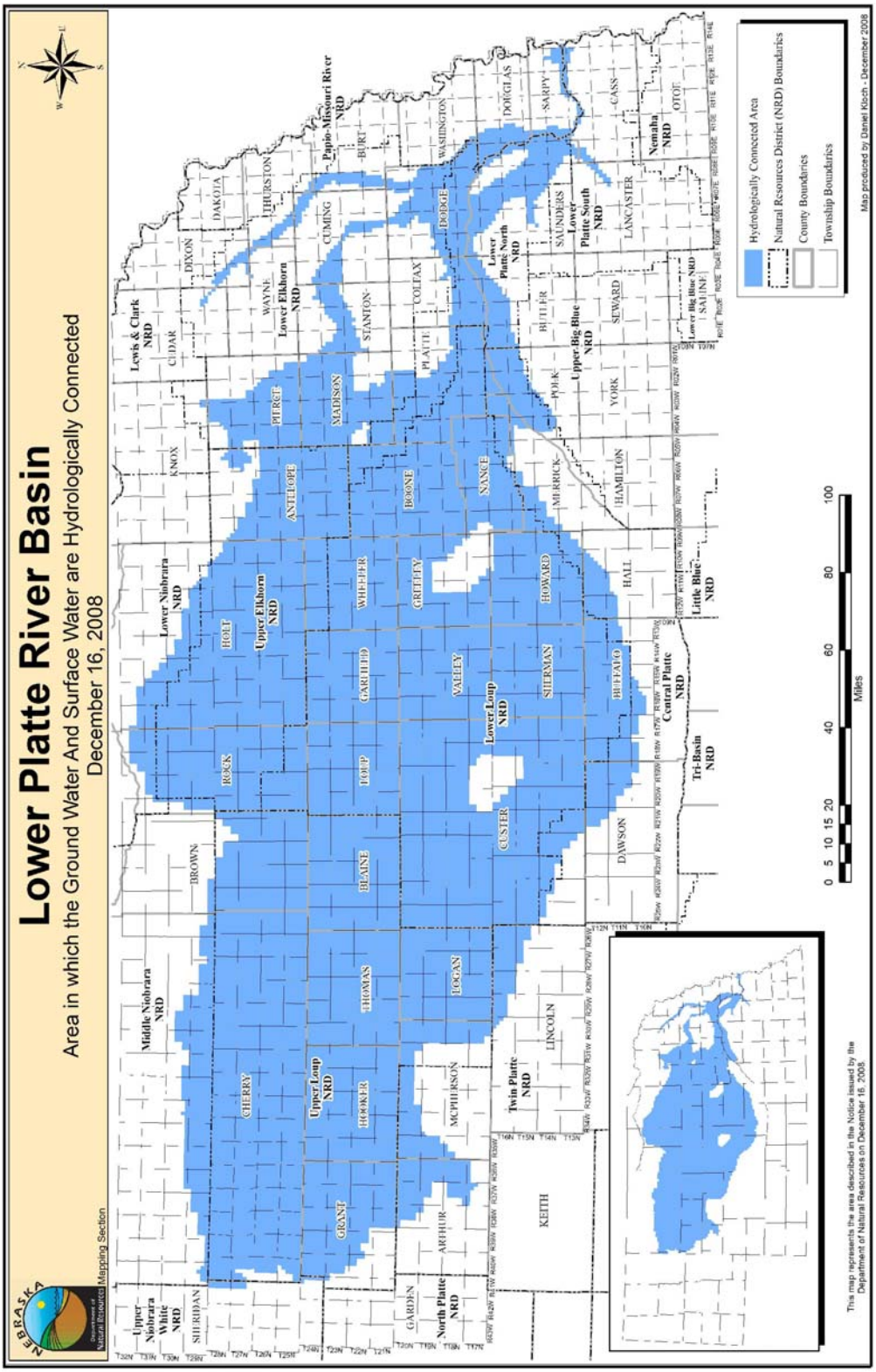


Figure 7-12 Area designated as hydrologically connected to the fully appropriated portion of the Lower Platte River Basin.



7.9 Relevant Data Provided by Interested Parties

The Department published a request for relevant data from interested parties for this year's evaluation on May 12, 2008 (see Appendix A for Affidavit). The Department did not receive any such information.

7.10 Conclusions

Based on the analysis of the sufficiency of the long-term surface water supply in the Lower Platte River Basin, the Department has reached a preliminary conclusion that, even without the initiation of additional uses, the basin upstream of the confluence with the Missouri River is presently fully appropriated. The designation is the result of two factors. The first factor is that the current levels of groundwater development will result in lag impacts such that the future water supply will be insufficient for junior surface water appropriations to satisfy the 65/85 rule. The second factor is that those same junior surface water appropriations are currently receiving less water than was available at the time the appropriations were granted (i.e., they have been eroded).

Bibliography of Hydrogeologic References for Lower Platte River Basin

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